Relative laboratory volatility of Dicamba in closed dome systems with varied pH, temperature, and relative humidity

Report:	MRID 51017509. Valentin, H.E. 2020. Determination of the Relative Dicamba Volatility of MON 76980 Under Various Environmental Conditions in Closed Dome Systems. Unpublished study performed and sponsored by Monsanto Company, Chesterfield, Missouri, and Monsanto Company, St. Louis, Missouri (p. 54). Report No. MSL0030928. Study No. REG-2019-0508. Experiment initiated September 10, 2019 and terminated November 7, 2019 (p. 6). Final report issued January 14, 2020.
Document No.:	MRID 51017509
Guideline:	Non-guideline
Statements:	The study was conducted in compliance with U.S. EPA FIFRA (40 CFR Part 160) GLP standards (p. 3). Signed and dated GLP Compliance, Data Confidentiality, Quality Assurance, and Certification of Authenticity statements were provided (pp. 2-5).
Classification:	This study is **supplemental, non-guideline**. The test soil consisted of 50% Redi-Earth, a soil with a large amount of sphagnum peat moss, which would make it very high in organic carbon. Results of this study should not be used quantitatively except for soils with an organic carbon content greater than or equal to that of peat soil. Differences in volatility should be regarded as relative, not absolute. Concentrations of dicamba were measured above the level of quantitation in the water control.

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Final EPA Reviewer:	Chuck Peck Senior Fate Scientist	Signature: Chuck Peck 2020.10.22 08:42:34 -04'00' Date:
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This Data Evaluation Record may have been altered by the Environmental Fate and Effects Division subsequent to signing by CDM/CSS-Dynamac Joint Venture personnel. The CDM/CSS-Dynamac JV role does not include establishing Agency policies

Executive Summary

In a laboratory study, the relative dicamba volatility of MON 76980 XtendiMax with VaporGrip™ (pH 5.15) was investigated on uncharacterized soil (50% Redi-Earth and 50% US10 field soil mix) under aerobic soil conditions at three temperatures (30°C, 35°C, and 40°C) with humidity levels of 40%, 50% and 60% for a period of 24 hours. In order to study the effects of pH, the test material was mixed with water or KOH to generate the following three test substances: MON 76980 XtendiMax with VaporGrip™ (pH 5.17), MON 301785 XtendiMax with VaporGrip™ (pH 3.97), and MON 301784 XtendiMax with VaporGrip™ (pH 6.36). Soil samples were treated after experiment initiation (September 10, 2019) at a target application rate of *ca.* 0.558 kg a.i./ha (*ca.* 0.5 lb a.i./A), which is the typical use rate. Three replicates for each experimental condition were examined in the study. Polyurethane foam (PUF) samples were collected for 24 hours after treatment at a uniform flow rate of 2 L/minute. The PUF samples were extracted using methanol, and dicamba was quantitated using LC-MS/MS. No analyses of dicamba in soil were performed.

Mean measured mass for the 40°C experimental data (40-60% relative humidity) ranged from 27.03 to 41.73 ng/PUF for MON 301784 (pH 6.36), from 109.10 to 200.00 ng/PUF for MON 301785 (pH 3.97), and from 33.40 to 77.80 ng/PUF for MON 76980 (pH 5.17). Mean measured mass for the 35°C experimental data (40-60% relative humidity) ranged from 10.24 to 31.50 ng/PUF for MON 301784 (pH 6.36), from 34.17 to 37.97 ng/PUF for MON 301785 (pH 3.97), and from 11.65 to 18.50 ng/PUF for MON 76980 (pH 5.17). Mean measured mass for the 30°C experimental data (40-60% relative humidity) ranged from 5.88 to 7.24 ng/PUF for MON 301784 (pH 6.36), from 13.68 to 18.93 ng/PUF for MON 301785 (pH 3.97), and from 8.67 to 19.77 ng/PUF for MON 76980 (pH 5.17).

After 24 hours, air concentrations ranged from 1.55 to 20.5 ng/m^3 for MON 301784 (pH 6.36), 1.76 to 46.5 ng/m^3 for MON 76980 (pH 5.17), 3.17 to 94.1 ng/m^3 for MON 301785 (pH 3.97), and 0.57 to 5.87 ng/m^3 for water (control). Flux rates ranged from 0.0004 to 0.005 ng/m^2-s for MON 301784 (pH 6.36), 0.00045 to 0.012 ng/m^2-s for MON 76980 (pH 5.17), 0.00082 to 0.024 ng/m^2-s for MON 301785 (pH 3.97), and 0.0.00015 to 0.00152 ng/m^2-s for water (control).

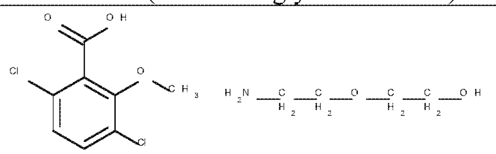
Using regression analysis of the volatility data showed the direction and the relative magnitude of the dicamba volatility change as a function of the different environmental factors tested, the study author determined an importance order of the significant predictor variables (p values at or below 0.05) of dicamba volatilization as Temperature > pH > Temperature*pH. Additionally, the study author determined that the variables Relative Humidity, Relative Humidity*pH, and Relative Humidity*Temperature also correlated with dicamba volatility, but the effects were not significant in this study at p value criteria of 0.05 or lower. In general, study authors and the reviewer concluded that volatility tended to increase as the temperature in the closed dome increased and that volatility tended to increase as pH of the formulation decreased.

I. Material and Methods

A. Materials

1. Test Material

Table 1. Properties of Test Materials

Property	MON 76980	MON 301785[1]	MON 301784[1]
Product Name	MON 76980 XtendiMax with VaporGrip™	MON 301785 XtendiMax with VaporGrip™	MON 301784 XtendiMax with VaporGrip™
Formulation Type	Liquid		
Typical end-use product?	Yes	No	
Contaminants and/or impurities	28.67% acid equivalent (a.e.) dicamba diglycolamine (DGA) salt formulation (EPA Reg No. 524-617); contaminants not reported	29.60% acid equivalent (a.e.) dicamba diglycolamine (DGA) salt formulation; contaminants not reported	29.73% acid equivalent (a.e.) dicamba diglycolamine (DGA) salt formulation; contaminants not reported
Manufacture #	Not reported		
Lot #	11493551	11509795	11509794
Type of radiolabel	Not radiolabeled		
Specific radioactivity	Not applicable		
Radiochemical purity	Not applicable		
CAS #	104040-79-1 (dicamba diglycolamine salt)		
Chemical structure			
Storage stability	Not reported		
pH	5.17 (expected pH 5.15)	3.97 (targeted pH 4.00)	6.36 (targeted pH 8.00)

Data obtained from pp. 9-10, and Appendix B, pp. 56, 59, of the study report unless otherwise indicated.
[1] MON 301785 and MON 301784 were prepared from MON 76980 using KOH to adjust the pH. No other constitution difference between the dicamba DGA formulations was reported.

2. Storage Conditions

The storage conditions of the test material were not reported (p. 10; Appendix B, p. 56).

3. Soil

Soil characterization is provided in **Table 2.** According to ASTM STP1587, on which the humidome studies are based, in order to minimize variability due to the soil composition, a one to one mixture of field soil and Redi-Earth was used. Although different soil types may impact volatility, the use of this standard soil mixture was selected to help reduce the impact of the variability of soil content. According to information obtained from the Internet (http://www.sungro.com/professional-product/sunshine-redi-earth-plug-seedling/), Redi-Earth is a mixture of fine sphagnum peat moss, dolomite lime, and vermiculite, which is an indication that the mixture contains a high level of organic carbon.

Table 2. Soil(s) Collection, Storage and Properties

Property	Value
Geographic location	Not reported
Pesticide use history at the collection site	Not reported
Collection date	Not reported
Collection procedures	Not reported
Sampling depth	Not reported
Storage conditions	Not reported
Storage duration	Not reported
Soil preparation	50% Redi-Earth and 50% US10 field soil mix (sifted with a ¼-in (0.635 cm) opening sieve screen)
Soil texture (USDA):	Not reported
% Sand	Not reported
% Silt	Not reported
% Clay	Not reported
pH (water)	Not reported
Organic carbon (%)[1]	Not reported
Organic matter (%) (LOI)	Not reported
CEC (meq/100 g) (Method not reported)	Not reported
Soil Moisture Content (%):	Not reported
At 0.1 bar (pF 2.0)	Not reported
At 1/3 bar (pF 2.5)	Not reported
Bulk density (g/cm^3)	Not reported
Microbial biomass:	
At initiation	Not reported
At termination	Not reported
Soil taxonomic classification (WRB)	Not reported

Data obtained from p. 10 of the study report.

B. Study Design

1. Experimental Conditions

Closed dome systems (humidomes) were configured to capture vapor phase dicamba on PUF sampling tubes following the application of either MON 76980, MON 301785, or MON 301784 to soil (pp. 10-12; Appendix B, pp. 59-60). The humidomes were disposable, plastic, sealed containers that allow for controlled environmental conditions and were modified to allow dicamba sample collection on the PUF media. Assembled, closed humidomes (10" wide x 20" long x 3" deep, with lids that were 11" wide x 21" long x 6" high) were placed in a temperature and humidity controlled environmental chamber. On each humidome lid a 15/16" diameter air outlet hole on one end of the disposable, clear, plastic dome lid was cut for insertion of the PUF sample tube. The hole was located two inches from the top of the lid. Lids designated for collection of a duplicate PUF sample had a second 15/16" hole cut two inches from the top of the lid and two inches laterally from the first hole. All lids had an air inlet hole on the opposite end to allow the free flow of air through the humidome. This hole was plugged with a #4 rubber stopper after the lid was mounted on the dosed soil tray and until an experiment began. The labelled PUF sample tube was mounted to one of the holes cut into each lid. The PUF tube extended *ca.* 1 inch into the humidome. The PUF tube was securely mounted to the lid with a silicone sheath holding it in place. PUF sample tubes were installed on the lid immediately prior to installation over the bottom tray loaded with the dosed soil.

Argus Controls software was used to monitor the controlled temperature and humidity in the environmental growth chamber (p. 12; Appendix B, pp. 61-63). Chamber lights were programmed to be on for 14 hours and off for 10 hours. After 24 hours, the PUF samples were removed from the lid of the humidome, rubber stoppers are inserted into the air inlet holes, and the humidome was removed from the environmental chamber.

Table 3. Experimental Design

Parameter		Description
Duration of the test (hours)		24 for each test
Soil condition (Air dried/fresh)		Mixed, non-compacted, sifted with a ¼-in (0.635 cm) opening sieve screen
Soil sample weight (g/replicate)		1 L (soil wt. not reported)
Soil depth (cm)		*ca.* 1
Test concentration (mg ai/kg soil (dry weight))[1]		Soil wt. not reported 225 g/acre for MON 76980 (pH 5.17) and MON 301785 (pH 3.97), and 233 g/acre for MON 301784 (pH 6.36).
Field Equivalent Application Rate (lb a.i./A)		*ca.* 0.5 [*ca.* 22 oz/acre for MON 76980 (typical use rate)]. 22 oz/acre for MON 76980 is equivalent to 226 g ai/acre based on the target dicamba concentration of 29 % (w/w) and with the measured density of 1.1975 g/mL.
Number of replicates		3
Test apparatus		Closed dome systems (humidomes) configured to capture dicamba on polyurethane foam media.
Test material application	Test solution volume used/ treatment[2]	10 gallons per acre (GPA) with the formulation which had been diluted with deionized water to a dicamba acid concentration of *ca.* 0.6% (w/w).
	Application method	Track sprayer inside a fume hood with a 9501E nozzle tip (TP9501E nozzle, TeeJet Technologies) at 16 inches above the soil
Indication of test material adsorbing to walls of test apparatus?		No
Experimental conditions	Temperature (°C)	30°C, 35°C, and 40°C
	Relative humidity	40%, 50%, and 60%
	Soil moisture content	Not reported
	Moisture maintenance method	Not reported
	Air flow through system	2 L/minute
	Continuous darkness (Yes/No):	No; 14-hour day light cycle. The light cart was set at 65 µmol photons/m^2/s ± 30 µmol photons/m^2/s.
Other observations (if applicable)		

Data obtained from pp. 10-12, and Appendix B, pp. 60-62, of the study report.
[1] Not reported; could not be calculated since soil weight per replicate and soil density not reported.

2. Sampling during Study Period

After 24 hours, the vacuum pump was turned off, and the glass sampling tubes containing the PUFs were removed and individually wrapped in aluminum foil prior to processing and analysis (p. 13; Appendix B, p. 64).

No soil samples were collected.

Table 4. Sampling Design

Parameter	Description
Air Sampling	
Sample intervals (hrs)	24
Sampling method	Polyurethane foam sample tubes
Desired air flow of sampler (L/min)	2
Sample storage before analysis (Yes/No)?	No; analyzed within 4 hours of sampling
Soil Sampling	
Sample intervals	Not sampled
Sampling method	Not sampled
Sample storage before analysis (Yes/No)?	Not sampled

Data obtained from p. 12 and Appendix B, p. 64, of the study report.

3. Sample Handling and Storage Stability

After collection, samples were removed from the humidomes, wrapped in foil, and analyzed within four hours (p. 13; Appendix B, p. 64). Method ME-1902-02 reported that samples should be stored at *ca*. -20°C for extended periods (Appendix A, p. 37).

4. Analytical Procedures

Extraction methods: Polyurethane foam air sampling traps were spiked with 0.1 mL of acetonitrile then extracted in a single extraction using methanol containing stable-labeled internal standard (Method ME-1902-02; p. 13; Appendix A, pp. 31, 37-38). The sample tubes were capped and agitated on a high-speed shaker for 30 minutes. An aliquot of the supernatant was filtered, evaporated under nitrogen gas at 50ºC, and reconstituted in up to 10-fold less volume of 25% methanol in water. Dicamba was quantitated using LC-MS/MS with electrospray ionization in negative ion mode.

Total Radioactivity Measurement: Not applicable

Identification and Quantification of Parent Compound: Aliquots of the sorbent extracts were analyzed for dicamba using LC-MS/MS under the following conditions (Method ME-1902-02; p. 13; Appendix A, pp. 31, 40-41):

HPLC	Shimadzu Prominence 20A
Mass Spectrometer	AB Sciex API 5000/5500
Switching Valve	Rheodyne, 6 port
Data Software	AB Sciex Analyst
Column	Phenomenex Kinetex Phenyl-Hexyl (2.10 × 100 mm, 2.6-µm)
Mobile Phase	A: Water with 0.1% formic acid B: Methanol with 0.1% formic acid

Time (minutes)	% B	Flow Rate (mL/min.)	Divert
0	25	0.3	To MS
0.5	25	0.3	To MS
1.0	50	0.3	To MS
4.0	61	0.3	To MS
4.1	95	0.3	To MS
5.5	95	0.3	To waste
5.6	95	0.6	To waste
10.9	95	0.6	To waste
11.0	25	0.6	To waste
11.5	25	0.6	To waste
11.6	25	0.3	To waste
15.0	25	0.3	Stop

Column Temperature	50ºC
Autosampler Temp	4ºC
Injection Volume	50 µL
Ionization Mode	ESI, negative ion mode
Curtain Gas	Nitrogen, 10 psi
Collision Gas	2 psi
IonSpray Voltage	-2000 V
Source Temperature	450ºC
Ion Source Gas 1	Nitrogen, 50 psi
Ion Source Gas 2	Nitrogen, 50 psi
Interface Heater	On
Probe Position	Not reported
MRM Transitions	219/175 Da (Dicamba); 225/181 Da (Dicamba-$^{13}C_6$)
Confirmatory Ions	221/177 Da (Dicamba); 227/183 Da (Dicamba-$^{13}C_6$)
Declustering Potential	-45 V
Entrance Potential	-10 V
Collision Energy	-10 V
Collision Cell Exit Potential	-10 V

Detection Limits (LOD, LOQ) for the Parent Compound: The limit of detection (LOD) was determined to be 0.065-0.094 ng/PUF, with a limit of quantitation (LOQ) of 0.30 ng/PUF (Method ME-1902-02; Appendix B, pp. 47-48).

Detection Limits (LOD, LOQ) for the Transformation Products: No transformation products were evaluated in the study.

Instrument performance: A calibration curve based on calibration standards covering at least five concentration levels for dicamba was calculated for every sample set (Appendix A, pp. 35, 37, 39). The concentrations of the standards bracketed the expected concentrations in the samples being analyzed.

Lab recovery, air sampling sorbent material: All laboratory spike recoveries are within the acceptable range with overall recoveries at 71-110% (Appendix B, p. 49).

Lab recovery, soils: Not applicable

Breakthrough, air samples: Validation assessments for breakthrough characterization showed that no test substance breakthrough was found for the PUF air sampling traps under the sampling conditions of 5 L/min for 12 hours (Appendix B, p. 50).

II. Results and Discussion

A. Data

Sample durations, sample volume flowrates, and the mass of dicamba collected on the sorbent material (mean ± standard deviation) for each dicamba DGA formulation and the control (water) are shown in **Table 5**. Air concentrations were reviewer-calculated by dividing the reported mass of dicamba by product of the sample volume flowrate and sample duration (p. 12; Table 2, pp. 14-15). After 24 hours, air concentrations ranged from 1.55 to 20.5 ng/m^3 for MON 301784 (pH 6.36), 1.76 to 46.5 ng/m^3 for MON 76980 (pH 5.17), 3.17 to 94.1 ng/m^3 for MON 301785 (pH 3.97), and 0.57 to 5.87 ng/m^3 for water (control).

B. Material Balance

No material balance or distribution of dicamba in the air and soil was calculated in the study. Based on the amount of dicamba applied (225 g ai/A for pH of 3.97 or 5.17 and 233 g ai/A for pH 6.36), after 24 hours, the percent of dicamba volatilized ranged from 0.603 to 7.96 x 10^{-4} % for MON 301784 (pH 6.36), 0.707 to 18.7 x 10^{-4} % for MON 76980 (pH 5.17), 1.28 to 37.9 x 10^{-4} % for MON 301785 (pH 3.97).

C. Study Conditions

Temperature and relative humidity were maintained throughout the study in the environmental chamber (p. 12; Appendix B, pp. 61-62). Soil moisture measured prior to applying test material was not reported or evaluated during the trial. Microbial biomass was not evaluated.

D. Transformation Products

The study did not evaluate transformation products.

E. Volatilization

After 24 hours, flux rates ranged from 0.0004 to 0.005 ng/m^2-s for MON 301784 (pH 6.36), 0.00045 to 0.012 ng/m^2-s for MON 76980 (pH 5.17), 0.00082 to 0.024 ng/m^2-s for MON 301785 (pH 3.97), and 0.0.00015 to 0.00152 ng/m^2-s for water (control).

Table 5. Volatility of dicamba from soil after 24 hours

Temperature		30°C			35°C			40°C		
Relative Humidity		40%	50%	60%	40%	50%	60%	40%	50%	60%
Air Concentration Analyses – MON 301784 (pH 6.36)										
Sample Duration (hours)		24	24	24	24	24	24	24	24	24
Sample Volume Flowrate (m^3/s)		3.33E-05	3.33E-05	3.33E-05	3.33E-05	3.33E-05	3.33E-05	3.33E-05	3.33E-05	3.33E-05
Parent	Measured mass (ng)	7.24 ± 2.76	6.85 ± 0.27	5.88 ± 1.16	10.30 ± 2.35	10.24 ± 4.78	31.50 ± 23.96	41.73 ± 7.42	27.30 ± 5.41	27.03 ± 17.09
	Air concentration (ng/m^3)	2.52 ± 0.96	2.38 ± 0.09	2.04 ± 0.40	3.58 ± 0.82	3.55 ± 1.66	10.94 ± 8.32	14.49 ± 2.58	9.48 ± 1.88	9.39 ± 5.93
	Volatility (ng/m^2-s)	0.00065 ± 0.0002	0.00061 ± 0.0000	0.00053 ± 0.0001	0.00092 ± 0.0002	0.00092 ± 0.0004	0.00283 ± 0.0021	0.00374 ± 0.0007	0.00245 ± 0.0005	0.00243 ± 0.0015

Data obtained for measured mass from Table 2, pp. 14-15 and flowrate and duration from p. 12 of the study report. Reported values are means of three replicates, with standard deviations. Reviewer converted units from those reported in the study to those reported here.

Temperature		30°C			35°C			40°C		
Relative Humidity		40%	50%	60%	40%	50%	60%	40%	50%	60%
Air Concentration Analyses – MON 76980 (pH 5.17)										
Sample Duration (hours)		24	24	24	24	24	24	24	24	24
Sample Volume Flowrate (m^3/s)		3.33E-05	3.33E-05	3.33E-05	3.33E-05	3.33E-05	3.33E-05	3.33E-05	3.33E-05	3.33E-05
Parent	Measured mass (ng)	17.18 ± 15.04	8.67 ± 5.83	19.77 ± 14.77	18.50 ± 2.46	11.65 ± 2.18	16.17 ± 0.50	77.80 ± 50.13	70.97 ± 47.00	33.40 ± 26.45
	Air concentration (ng/m^3)	5.96 ± 5.22	3.01 ± 2.02	6.86 ± 5.13	6.42 ± 0.85	4.05 ± 0.76	5.61 ± 0.17	27.01 ± 17.41	24.64 ± 16.32	11.60 ± 9.18
	Volatility (ng/m^2-s)	0.00154 ± 0.0014	0.00078 ± 0.0005	0.00177 ± 0.0013	0.00166 ± 0.0002	0.00105 ± 0.0002	0.00145 ± 0.0000	0.00698 ± 0.0045	0.00637 ± 0.0042	0.00300 ± 0.0024

Data obtained for measured mass from Table 2, pp. 14-15 and flowrate and duration from p. 12 of the study report. Reported values are means of three replicates, with standard deviations. Reviewer converted units from those reported in the study to those reported here. Volatilities were not provided in the study.

Temperature		30°C			35°C			40°C		
Relative Humidity		**40%**	**50%**	**60%**	**40%**	**50%**	**60%**	**40%**	**50%**	**60%**
Air Concentration Analyses – MON 301785 (pH 3.97)										
Sample Duration (hours)		24	24	24	24	24	24	24	24	24
Sample Volume Flowrate (m^3/s)		3.33E-05	3.33E-05	3.33E-05	3.33E-05	3.33E-05	3.33E-05	3.33E-05	3.33E-05	3.33E-05
Parent	**Measured mass (ng)**	18.93 ± 10.88	15.78 ± 10.02	13.68 ± 3.95	35.27 ± 4.32	37.97 ± 4.01	34.17 ± 6.45	200.00 ± 62.95	184.33 ± 37.58	109.10 ± 36.28
	Air concentration (ng/m^3)	6.574 ± 3.78	5.48 ± 3.48	4.75 ± 1.37	12.25 ± 1.50	13.18 ± 1.39	11.86 ± 2.24	69.44 ± 21.86	64.00 ± 13.05	37.88 ± 12.60
	Volatility (ng/m^2-s)	0.00170 ± 0.0010	0.00142 ± 0.0009	0.00123 ± 0.0004	0.00316 ± 0.0004	0.00341 ± 0.0004	0.00307 ± 0.0006	0.01794 ± 0.0056	0.01654 ± 0.0034	0.00979 ± 0.0033

Data obtained for measured mass from Table 2, pp. 14-15 and flowrate and duration from p. 12 of the study report. Reported values are means of three replicates, with standard deviations. Reviewer converted units from those reported in the study to those reported here. Volatilities were not provided in the study.

Temperature		30°C			35°C			40°C		
Relative Humidity		**40%**	**50%**	**60%**	**40%**	**50%**	**60%**	**40%**	**50%**	**60%**
Air Concentration Analyses – Water (control)										
Sample Duration (hours)		24	24	24	24	24	24	24	24	24
Sample Volume Flowrate (m^3/s)		3.33E-05	3.33E-05	3.33E-05	3.33E-05	3.33E-05	3.33E-05	3.33E-05	3.33E-05	3.33E-05
Parent	**Measured mass (ng)**	4.22 ± 3.49	4.02 ± 1.67	2.43 ± 0.44	4.27 ± 1.62	8.24 ± 2.14	12.65 ± 4.99	6.45 ± 4.49	3.06 ± 0.92	4.76 ± 0.69
	Air concentration (ng/m^3)	1.46 ± 1.21	1.39 ± 0.58	0.84 ± 0.15	1.48 ± 0.56	2.86 ± 0.74	4.39 ± 1.73	2.24 ± 1.56	1.06 ± 0.32	1.65 ± 0.24
	Volatility (ng/m^2-s)	0.00038 ± 0.0003	0.00036 ± 0.0001	0.00022 ± 0.0000	0.00038 ± 0.0001	0.00074 ± 0.0002	0.00113 ± 0.0004	0.00058 ± 0.0004	0.00027 ± 0.0001	0.00043 ± 0.0001

Data obtained for measured mass from Table 2, pp. 14-15 and flowrate and duration from p. 12 of the study report. Reported values are means of three replicates, with standard deviations. Reviewer converted units from those reported in the study to those reported here. Volatilities were not provided in the study.

The study author evaluated the relative dicamba volatility observed under the different treatment conditions, using variance component analysis (p. 13). The results of a regression analysis of the volatility data showed the direction and the relative magnitude of the dicamba volatility change as a function of the different environmental factors tested (see **Table 6** below).

Table 6. Estimated coefficients from regression analysis.

Parameter	Estimated Coefficients	Std Err	t Value	p Value Sig
Temperature	0.727102720	0.05702296	12.75	<0.0001*
pH	-0.469337233	0.05702296	-8.23	<0.0001*
Temperature*pH	-0.140686514	0.05737825	-2.45	0.01066*
Humidity*Temperature	-0.100846670	0.05737825	-1.76	0.0930
Humidity	-0.071050911	0.05702296	-1.25	0.2167
Humidity*pH	0.063903827	0.05737825	1.11	0.2690

Data obtained from p. 17, of the study report.
Regression coefficients represent the mean change in the response variable for one unit of change in the predictor variable while holding other predictors constant.
* p value at or below 0.05.

Based on this data, the study author determined an importance order of the significant predictor variables (p values at or below 0.05) of dicamba volatilization as Temperature > pH > Temperature*pH. Additionally, the study author determined that the variables Relative Humidity, Relative Humidity*pH, and Relative Humidity*Temperature also correlated with dicamba volatility, but the effects were not significant in this study at p value criteria of 0.05 or lower.

The reviewer conducted a correlation analysis of the data in Excel, examining the same parameters as the study authors. **Table 7** shows the correlation coefficients, which follow a similar trend as those proposed by the study authors for temperature and pH. None of the trends were considered strong (> 0.8, < 0.8), but the dicamba residues were somewhat correlated with temperature and somewhat negatively correlated with pH and humidity*pH.

Table 7. Estimated correlation coefficients

Parameter	Estimated Coefficients
Temperature	0.57009
pH	-0.41739
Temperature*pH	-0.09398
Humidity*Temperature	0.21955
Humidity	-0.11811
Humidity*pH	-0.37669

III. Study Deficiencies and Reviewer's Comments

1. Concentrations of dicamba were measured above the level of quantitation in the water control. Study authors did not address the levels in the controls.

2. The test soil was not characterized. ASTM protocol STP1587, used in the conduct of this study, requires that "In order to minimize variability due to the soil composition, a one to one mixture of US10 field soil and Redi-Earth was used. Although different soil types may impact volatility, using this standard soil mixture helped reduce the impact of this variable." Results of this study should not be used quantitatively except for soils with an organic carbon content greater than or equal to that of peat soil. Differences in volatility should be regarded as relative, not as absolute values.

3. The stability of dicamba was not reported. The analytical method indicated that the stability of the processed and partially processed samples was up to 6 days at *ca*. 4°C (Appendix B, p. 50).

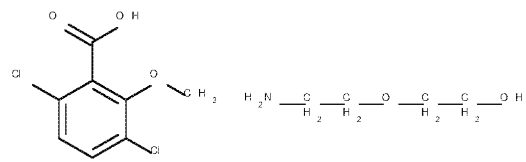
IV. References

1. U.S. Environmental Protection Agency. 2008. Fate, Transport and Transformation Test Guidelines, OCSPP 835.1410, Laboratory Volatility. Office of Chemical Safety and Pollution Prevention, Washington, DC. EPA 712-C-08-011.

2. Gavlick, W.K., Wright, D.R., MacInnes, A., Hemminghaus, J.W., Webb, J.K., Yermolenka, V.I., and Su, W. 2016. "A Method to Determine the Relative Volatility of Auxin Herbicide Formulations," Pesticide Formulation and Delivery Systems: 35th Volume, ASTM STP1587, G.R. Goss, Ed., ASTM International, West Conshohocken, PA, pp. 24-32. doi:10.1520/STP158720150006.

3. Gavlick, W.K. 2016. "Evaluation of Dicamba Breakthrough for a PUF Based Air Sampling System". MSL0026676.

DER ATTACHMENT 1. Dicamba-diglycolamine and Its Environmental Transformation Products. [A]

Code Name/ Synonym	Chemical Name	Chemical Structure	Study Type	MRID	Maximum %AR (day)	Final %AR (study length)
PARENT						
Dicamba-diglycolamine (MON 76980; Diglycolamine salt of dicamba)	**IUPAC:** 3,6-Dichloro-o-anisic acid-2-(2-aminoethoxy)ethanol **CAS:** 2-(2-Aminoethoxy)ethanol;3,6-dichloro-2-methoxy-benzoic acid **CAS No.:** 104040-79-1 **Formula:** $C_{12}H_{17}Cl_2NO_5$ **MW:** 326.17 g/mol **SMILES:** COc1c(Cl)ccc(Cl)c1C(=O)O.NCCOCCO		Non-guideline	51017509	NA	NA
MAJOR (>10%) TRANSFORMATION PRODUCTS						
No major transformation products were identified.						
MINOR (<10%) TRANSFORMATION PRODUCTS						
No minor transformation products were identified.						
REFERENCE COMPOUNDS NOT IDENTIFIED						
All compounds used as reference compounds were identified.						

[A] AR means "applied radioactivity". MW means "molecular weight". NA means "not applicable".

Attachment 2: Statistics Spreadsheets and Graphs

128931_51017509_humidome data.xlsx